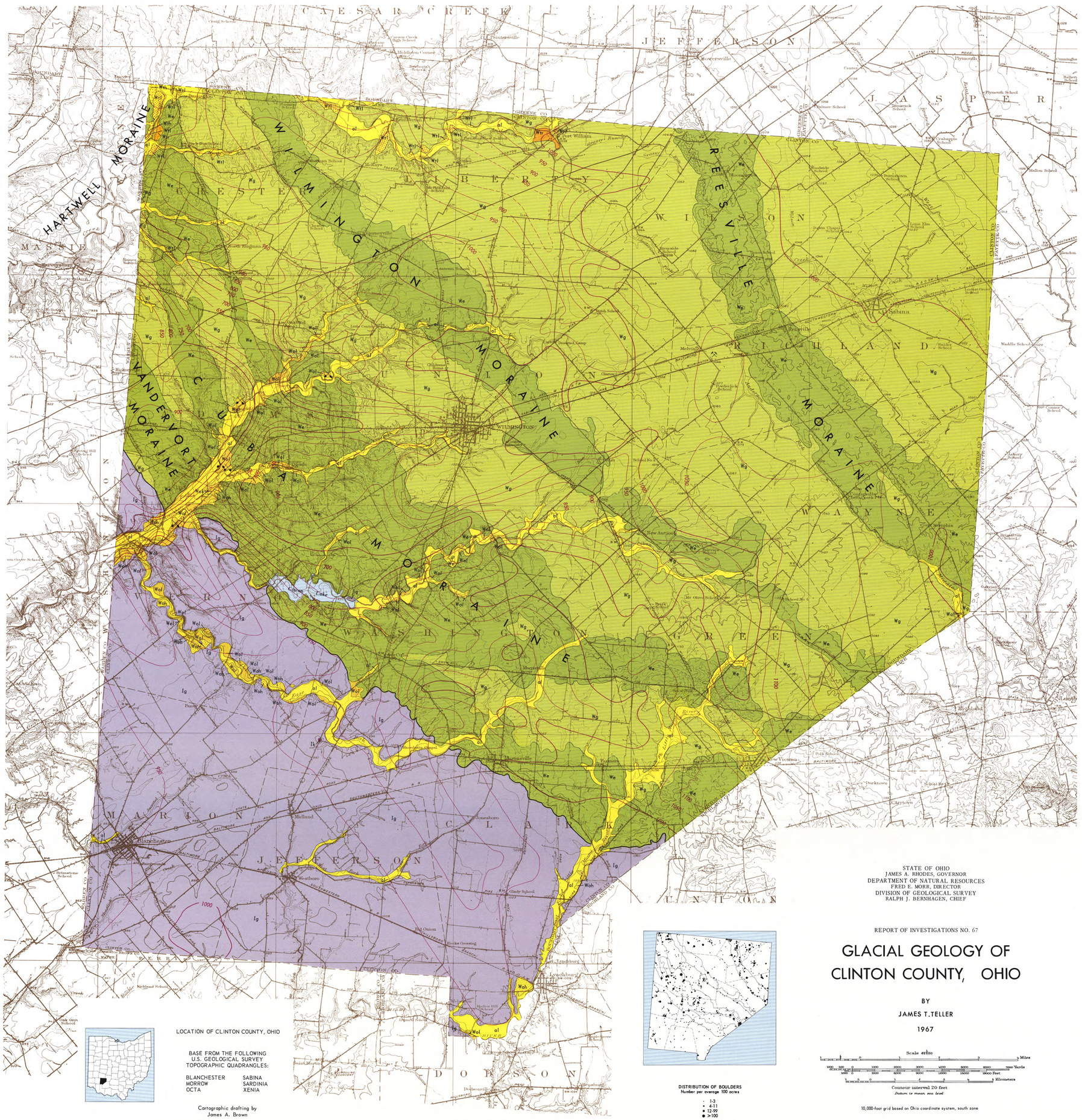
GLACIAL GEOLOGY OF CLINTON COUNTY, OHIO



EXPLANATION

- Recent
  - al — Alluvium
- Pleistocene
  - "Late" Wisconsin
    - Wol — Constructional outwash terrace, lower level
    - Woh — Constructional outwash terrace, higher level
    - Wrl — Constructional outwash terrace in Caesar Creek valley, lower level
    - Wrh — Constructional outwash terrace in Caesar Creek valley, higher level
    - Wtr — Terrace cut in bedrock
    - We — End moraine
    - Wg — Ground moraine
  - Illinoian
    - Ik — Kame
    - Ig — Ground moraine

QUATERNARY

- Boundary of deposit, *dashed where approximate*
- Boundary of Wisconsin glacial deposits
- Crestline of end moraine
- 800 — Contour on bedrock surface, *dashed where approximate, contour interval 50 feet*
- Quarry
- Gravel pit

GLACIAL GEOLOGY

INTRODUCTION

All of Clinton County has been glaciated. Illinoian drift is at the surface in the southwestern one-third of the county; Wisconsin deposits mantle the rest of the area. The underlying bedrock is Ordovician shale and limestone in the southwest and Silurian dolomite in the northeast. The Ordovician bedrock crops out along many of the streams in the southwestern part of the county but, except for a large active quarry at Melvin and a few small abandoned quarries near Wilmington, exposures of the Silurian dolomite are rare.

ILLINOIAN DEPOSITS

No pre-Illinoian drift has been recognized in Clinton County. However, Kansan(?) deposits in the Cincinnati area (Durrell, 1961, p. 55) indicate that a pre-Illinoian glacier did advance through the county and, locally, deposits of this age may be present at depth.

Illinoian ground moraine forms the extensive flat plains of southwestern Clinton County. Silt, believed to be mainly loess, composes a mantle two to five feet thick on the till. Locally it is possible to distinguish a humic gley soil within the silt mantle, suggesting that silts of both Illinoian and Wisconsin ages are present (Goldthwait, 1958, p. 211). It is likely that Illinoian silt is present throughout the area of Illinoian ground moraine, capped by Wisconsin silt that is thicker near the Wisconsin boundary and thinner toward the southwest.

Soils developed in the Illinoian till belong to the Cincinnati-Rossmoyne group, generally leached to a depth of 70-100 inches. Along the north shore of Cowan Lake, 1.2 miles northwest of Cuba, there is one unquestioned occurrence of Rossmoyne soils within the area of the outermost Wisconsin end moraine (Garner and Meeker, 1962). Presumably the Wisconsin glacier left no recognizable deposits on the Illinoian till at this place.

Illinoian drift has been found beneath calcareous Wisconsin till in three places: (1) north of the East Fork of Todd Fork, 1.4 miles west-northwest of Martinsville, along the west side of the road (Goldthwait and Forsyth, 1965, p. 68-69); (2) along the west bank of the East Fork of the Little Miami River, 0.8 mile southeast of Farmers and 3.2 miles east-southeast of Martinsville; and (3) on the south side of Trace Run, 2 miles west of North Kingman and 4 miles south of New Burlington. In each place, a buried Sangamon soil identifies the underlying Illinoian till. A layer of dark noncalcareous organic-rich accretion gley above the Sangamon soil probably represents accumulation by surface wash during "early" Wisconsin, or Altonian (Frye and Willman, 1960), time. There are other sites where accretion gley occurs between two tills, the upper till clearly Wisconsin, but with no evidence of weathering in the underlying till to confirm its age (Teller, 1964).

Gravel, identified as Illinoian by the deeply leached (90 inches) Parke soils developed in it, is present along the margins of Todd Fork valley in the area of Illinoian ground moraine. There is little topographic expression of these outwash remnants and there are no pits or terraces.

Illinoian gravel also occurs in one small rise, approximately 10 feet high, 2.5 miles southwest of Cuba. This is interpreted as a small kame, despite its label of "Indian Mound" on some maps, and is the only ice-contact feature of either age of glaciation in Clinton County.

WISCONSIN DEPOSITS

Except for the Altonian accretion materials found in association with the buried Sangamon soils, no "early" Wisconsin drift, as defined by Forsyth (1965, p. 225), is recognized in Clinton County; all glacial deposits are "late" Wisconsin, or Woodfordian (Frye and Willman, 1960), in age. Nonglacial deposits older than "late" Wisconsin are present in the form of buried forest beds (zones rich in vegetal material and mollusks), encountered mostly in drilling and reported by many early writers (Austin, 1930; Leverett, 1902). Five information obtained elsewhere in the State (Goldthwait, 1958), many of these buried forest beds are interpreted as the surface accumulation of organic debris over which the "late" Wisconsin ice advanced.

At least one of these forest beds is known to be younger than the earliest advance of the "late" Wisconsin ice. A section on the east side of Todd Fork valley (0.9 mile west-northwest of Sligo; 5½ miles west of Wilmington) exposes a layer of noncalcareous organic-rich silty clay containing wood and mollusks; the clay is capped by calcareous till over sand and gravel and underlain by calcareous gravel. Mollusks present are *Pupoides albilabris* (C. B. Adams), *Triodopsis* sp., *Mesodon minuscula* (Binney), *Succinea* sp., and *Carychium exiguum* (Say) (identifications by Dr. A. La Rocque, The Ohio State University). Several pieces of wood from this zone have been identified as *Picea* (spruce) by Dr. G. W. Burns (Ohio Wesleyan University) and dated by Dr. J. G. Ogden III (Ohio Wesleyan University) at approximately 22,000 years B.P.

The most striking Wisconsin deposits in the county are the four end moraines which mark successive limits of ice of the Scioto Lobe. The Cuba and Reesville Moraines have been recognized for many years (Leverett, 1902), and the Vandervort and Wilmington Moraines are named here for the first time.

The Vandervort Moraine is the oldest and has been assigned a separate name because it is not only older than the adjacent Cuba Moraine but is also older than the Hartwell Moraine, the oldest Miami Lobe moraine to the west. Deposits of the two lobes meet in Warren County about 2 miles west of Harveysburg and age relationships in this area have long been a problem. A tentative solution has been provided by this study: stratigraphic and topographic evidence indicate that the Hartwell Moraine overlaps the outermost drift of the low Vandervort Moraine, which, to the northwest, is truncated at right angles by the overriding Hartwell Moraine.

The stratigraphic evidence was observed in two small gullies directly in front of the Hartwell Moraine. The more southerly gully contains thick silt (loess) over till, the typical Scioto Lobe stratigraphy of that area. A hundred feet to the north, this same sequence is overlain by an additional till capped by very thin silt, apparently the southernmost extent of the Hartwell Moraine, which here is capped by little or no silt.

Further to the east, the Vandervort Moraine is diagonally overlapped by the Cuba Moraine; some crests on the Cuba Moraine may reflect crests on the buried Vandervort Moraine. No evidence of actual overlap has been noted where the Cuba Moraine adjoins the Hartwell Moraine, but there are several channels cut across the Hartwell Moraine, occupying positions that meltwaters from the Cuba Moraine would probably have taken. These channels, first reported by Dale Garner (personal communication, 1963), are considered evidence that the Cuba Moraine is younger than the Hartwell. Thus, the sequence of events in this area appears to be: emplacement first of the Vandervort Moraine of the Scioto Lobe, then of the Hartwell Moraine of the Miami Lobe, and finally of the Cuba Moraine of the Scioto Lobe. This sequence is supported by radiocarbon dates, all on *Picea*: (1) pre-Cuba, post-Vandervort(?) buried forest material from the Todd Fork valley cut west of Sligo: 21,137 ±1,435 years B.P. (OWU-159) and 22,255±1,652 years B.P. (OWU-160); (2) Hartwell drift in Warren County, 9 miles west of Clarksville: 19,621±372 years B.P. (OWU-102) (Garner and Forsyth, 1965, p. 94-95); and (3) Cuba drift, from a farm pond 1.1 miles southeast of Cuba: 18,500±420 years B.P. (Y-468) (Goldthwait, 1958, p. 216). The only other radiocarbon date from Clinton County has no bearing on this problem: till beneath "late" Wisconsin outwash 1 mile northeast of Clarksville has been dated at >37,000 years B.P. (Y-473-1). Such a date could indicate an age of either "early" Wisconsin or Illinoian for this till, probably the latter.

The Cuba Moraine is composed of two essentially parallel belts of end moraine, separated in places by stretches of ground moraine. Farther to the northeast is the low gently undulating Wilmington Moraine, which probably marks, as does the inner Cuba Moraine, a retreatal position of the glacier.

Silt 10-50 inches thick caps these Wisconsin till deposits. Diagnostic characteristics are lacking in most places, but because the silt is present on both low and high areas, it is generally considered to be loess. Although clear-cut channels in the later Reesville Moraine, still farther to the northeast, and the presence of bedded silt, sand, and local gravel at the base of the moraine point to a water-laid origin for the silt, it is likely that much of it was originally loess.

At the outer margin of the Reesville Moraine there is a clear-cut soil change. The soils developed in the tills of the Vandervort, Cuba, and Wilmington Moraines, and in the ground moraine associated with them, are Russell and Miami 60 soils, developed in till with a silt cap more (Russell) or less (Miami 60) than 18 inches thick (Forsyth, 1965, p. 224). Soil depths vary with the thickness of the silt cap, but are generally 35-60 inches in the Russell soil and 27-40 inches in the Miami 60 soil. Soils developed in the till of the Reesville Moraine are the Miami 6A soils; they lack a silt cap, contain a higher percentage of clay in the B horizon, and are shallower (generally 18-27 inches deep) than either Russell or Miami 60 soils. This striking soils change and the lack of any real silt cap, together with the more hummocky nature of the Reesville Moraine, have been interpreted to mean that this moraine does not represent a simple retreatal position of the ice but that, instead, the ice retreated out of Clinton County and then readvanced to the position of this moraine. This hypothesis is supported by an exposure in a small stream cut 2 miles southeast of Memphis, where the till of the Reesville Moraine is separated from an underlying till by a partially leached sand. In addition, Goldthwait (personal communication, 1964) reported a buried organic layer below the Reesville Moraine till, stratigraphy temporarily exposed during construction of Interstate 71.

Wisconsin outwash is present in all the deeper valleys. In general, two levels of constructional terrace are present, a higher level 25-55 feet above stream level and a lower level 15-30 feet above the stream. Near Clarksville, Todd Fork has eroded so deeply that the higher terrace is as much as 70 feet above it. The correlation of terraces in Caesar Creek valley with those of the Todd Fork drainage could not be determined within the bounds of this study. Cut terraces are present in all valleys at lower levels.

Boulders seem to be concentrated into belts (small map) just as they are farther to the north (Goldthwait, White, and Forsyth, 1961), but, as is the case elsewhere in the State, no good explanation is known for this distribution. It is clear that the boulders are generally more abundant on end moraine than on ground moraine, and that the greatest numbers of boulders are found on the Cuba and Reesville Moraines, which are believed to represent major readvances. It is possible that boulders are accumulated as lag features during glacial retreats and then are concentrated into belts by readvances of the ice.

Pebble counts (for details of procedure and results see Teller, 1964, p. 92-99) showed slightly higher percentages of crystalline pebbles for the Illinoian till and for the till of the Vandervort Moraine than for the other tills, a slightly lower percentage of sandstone and shale pebbles for the Illinoian, and a slightly higher limestone/dolomite pebble ratio for the Vandervort.

A number of extinct Pleistocene vertebrates have been found in Clinton County, all within a few miles of Wilmington. These include three groups of mastodon or mammoth fragments (teeth, tusks, bone), a partial skull of a giant beaver, two partial skulls of bear, and a group of 8-10 peccary skeletons (Austin, 1930; Teller, 1964, p. 100-105).

BURIED BEDROCK SURFACE

The surface of the bedrock beneath the glacial deposits has a maximum relief of more than 400 feet. Dissection is greatest in the west, where a valley was cut by the preglacial Hamilton River (Stout, Van Sneeg, and Lamb, 1943, p. 50), which flowed north out of Clinton County and then turned southwest to flow through the present site of Cincinnati (Norris, Cross, and Goldthwait, 1950, p. 12). Through much of the county, the modern Todd Fork valley follows that ancient buried valley.

The main trunk stream of the preglacial Teays River, which was contemporaneous with the Hamilton River, flowed through Clark County to the northeast (Cummins, 1959). It was separated from the Hamilton River by a bedrock divide that extends northwest-southeast through the eastern part of Clinton County and has an elevation of almost 1,100 feet, the highest on the buried bedrock surface. These two major preglacial rivers joined in Indiana (Norris, Cross, and Goldthwait, 1950, p. 12).

MINERAL RESOURCES

Wisconsin outwash in the lower reaches of the Todd Fork drainage is a significant source of sand and gravel and several active pits are located just upstream from Clarksville. Farther upstream, however, the deposits are thinner and of less value.

Important reserves of ground water are present in the outwash, most significantly in the outwash-bearing valleys tributary to Todd Fork. Small amounts of water are obtained locally from buried gravel in the uplands.

The dolomite quarried near Melvin and the rich agricultural soils developed in the glacial drift are also important to the economy of the county.

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BY
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